CLAIMS

1. A method of polarimetric measurement of a sample, represented by the coefficients of a Mueller matrix, in which the sample located inside an air tight chamber is illuminated by a polarised incident light beam produced by a polarisation state generator (PSG), said beam being reflected by the sample, analysed by a polarisation state detector (PSD) and then measured by detections means, said PSG, sample, PSD and detection means being located in at least an air tight chamber wherein,

- one illuminates the sample with a light beam in the spectral range from the far ultraviolet to the visible,
- one extracts the coefficients of the Mueller matrix from polarimetric measurements performed under a low partial pressure of far ultraviolet highly absorbing gases,

and

- one evacuates far ultraviolet highly absorbing gases by pumping down said chambers.

2. A method of polarimetric measurement according to claim 1, wherein one evacuates far ultraviolet highly absorbing gases by pumping down said chambers and then refilling said chambers with far ultraviolet non absorbing gas.

3. A method of polarimetric measurement according to claim 1 or 2, wherein the energy range of the incident light beam emitted by the excitation section is between 1.5 and 9.5 eV.

4. A method of polarimetric measurement according to any one of claims 1 to 3, wherein the parameters representative of the sample are measured by ellipsometry.

5. A method of polarimetric measurement according to claim 4, wherein the incident light beam is modulated by a phase modulator at a frequency ω, the intensity $I(t)$ measured by the detection means as a function of the modulation amplitude $\delta(t)$ is:

$$I(t)=I(I_0 + I_s \sin(\delta(t)) + I_c \cos(\delta(t)))$$

where $$\delta(t) = A_0 + A_1 \sin \omega t + \sum_{n=2} A_n \sin(n\omega t + \phi_n)$$

- a first Fourier-transform processing means analyses the signal $I(t)$ into Fourier components, $S_0(dc)$, S_1, S_2 at frequency ω and at frequency 2ω,

- second processing means produces values I_0, I_s, I_c from the measured harmonics S_0, S_1, S_2 according to the following relation:

$$\begin{pmatrix} S_0 \\ S_1 \\ S_2 \end{pmatrix} = I \begin{pmatrix} 1 & 0 & 0 \\ 0 & 2T_1 J_1(A) & 0 \\ 0 & 0 & 2T_2 J_2(A) \end{pmatrix} \cdot \begin{pmatrix} 1 & c_{s,0} & J_0(A)+c_{c,0} \\ 0 & 1 & c_{c,\omega} \\ 0 & c_{s,2\omega} & 1 \end{pmatrix} \cdot \begin{pmatrix} I_0 \\ I_S \\ I_C \end{pmatrix}$$

where J_0, J_1 and J_2 are the Bessel functions of order 0, 1, 2; T_1 and T_2 are specific constant of the detection means and $c_{c,0}$, $c_{s,0}$, $c_{s,\omega}$ and $c_{s,2\omega}$ describe the weak coupling between the three Fourier components, the modulation amplitude A being generally chosen such as $J_0(A) + c_{c,0}, = 0$:

$$S_\omega \sim T_1 I_S + c_{s,\omega} I_C$$
$$S_{2\omega} \sim T_2 I_C + c_{s,2\omega} I_S$$

The spectroscopic variations of (T_1, T_2) and ($c_{c,0}$, $c_{s,0}$, $c_{s,\omega}$ and $c_{s,2\omega}$) are calculated by fitting a polynomial variation to the experimental values measured with the orientations of said polarisation state generator, modulator and polarisation state detector, being respectively P, M and A, said calibration is performed according to configurations P – M = ± 45°; A = 0°, 90°; M = ± 45° and P – M = ± 45°; A = ± 45°; M = ± 45°,

- third processing means produces the value ψ and Δ from I_0, I_s, and I_c according to simple trigonometric formulae.

6. A method of polarimetric measurement according to claim 5, wherein a fourth degree polynomial is used for fitting the experimental values (T_1, T_2, $c_{c,0}$, $c_{s,0}$, $c_{s,\omega}$ and $c_{s,2\omega}$).

7. A method of polarimetric measurement according to claim 5 or 6, wherein the frequency ω of said modulator is between 30 and 60kHz.

8. Polarimetric system for analysing a sample comprising :

- an excitation section emitting a light beam, said excitation section comprising a polarisation state generator and optical means to focus said beam onto the sample,
- a sample holder,
- an analysis section comprising a polarisation state detector, detection means,

wherein

- the light beam emitted by the excitation section is in the spectral range from the far ultraviolet to the visible,

- the light beam propagates through the excitation section up to through the analysis section under a low partial pressure of far ultraviolet absorbing gases,

- the polarimetric system comprises at least an air tight chamber, said chambers containing said excitation section, said analysis section and the sample-holder,

and

- said chambers comprise a pumping station and pressure monitoring means.

9. Polarimetric system according to claim 8 wherein said chambers are interconnected so as to form a unique chamber.

10. Polarimetric system according to claim 8 or 9, wherein the pumping station comprises at least a primary pump.

11. Polarimetric system according to any one of claims 8 to 10, wherein the polarimetric system comprises heating means for heating said chambers or for the thermal stability of the optical components.

12. Polarimetric system according to claim 11 wherein the polarimetric system contains control means for regulating the temperature of the heating means within a predetermined temperature range.

13. Polarimetric system according to any one of claims 8 to 12, wherein the polarimetric system comprises a source of far ultraviolet non absorbing gases and means for introducing and evacuating said gases into said chambers.

14. Polarimetric system according to claim 13, wherein said gases comprises nitrogen (N_2).

15. Polarimetric system according to any one of claims 8 to 14, wherein the sample holder comprises means for tilting said sample holder controlled by external means.

16. Polarimetric system according to any one of claims 8 to 15, wherein the excitation section comprises a monochromator positioned before the polariser.

17. Polarimetric system according to any one of claims 8 to 15, wherein the detection means comprises a monochromator.

18. Polarimetric system according to any one of claims 16 and 17, wherein a slit is positioned at the entrance of said monochromator and focusing means focuses the beam onto the said entrance slit.

19. Polarimetric system according to claim 18, wherein said focusing means comprises a MgF_2 lens or another FUV transparent material.

20. Polarimetric system according to any one of claims 8 to 19, wherein the detection means comprises a first detector covering radiations in the spectral range from visible to ultraviolet and a second detector for radiations in the far ultraviolet spectrum.

21. Polarimetric system according to claim 20, wherein a diaphragm is located in front of the first detector and the second detector in order to reject parasitic beams.

22. Polarimetric system according to any one of claims 8 to 21, wherein said optical means comprises concave mirrors.

23. Polarimetric system according to claim 22, wherein said concave mirrors are coated with a protecting layer, said layer being in MgF_2.

24. Polarimetric system according to any one of claims 8 to 23, wherein said polarimetric system is an ellipsometer.